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(54) Title of the Invention: FIBER MOLDED PRODUCT FOR USE IN REINFORCED METAL, AND A METHOD FOR PRODUCING THE SAME

(57) [CLAIMS]

[CLAIM 1]

A method for producing a fiber molded product for use in a reinforced metal, comprising:

subjecting a mixture to pressure forming in which dehydration is not carried out, the mixture having a water content of 5 percent by weight (wt%) to 25 wt%, the mixture containing:

one or not less than two kinds of inorganic short fibers with a length of 0.01 mm to 3 mm, the inorganic short fibers being selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker, and

one or not less than two types of binders, the binders being selected from colloidal alumina, colloidal silica, and colloidal zirconium, and

carrying out dehydration by heating after the pressure forming.

[CLAIM 2]

A fiber molded product for use in a reinforced metal, comprising:

one or not less than two kinds of inorganic short fibers with a length of 0.01 mm to 3 mm, which are selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker, and

one or not less than two types of binders, which are selected from colloidal alumina, colloidal silica, and colloidal zirconium,

the fiber molded product having a void ratio of 60 % to 90 %, and a compression strength of not less than 4.6 kgf/cm^2.

[CLAIM 3]

A fiber molded product for use in a reinforced metal, comprising an inorganic short fiber with a length of 0.01 mm to 3 mm and a binder, and having a void ratio of 60 wt% to 95 wt%, wherein:

10 wt% to 70 wt% of mullite whisker and 30 wt% to 90 wt% of aluminum borate whisker are used as the inorganic fiber, and colloidal alumina is used as the binder.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical field to which the invention pertains]

The present invention relates to a fiber molded product for use in a reinforced metal, which is optimal to be filled in a light alloy cast product to complex the same, so as to form a fiber reinforced metal, as well as to a method for producing the same.

[0002]

[Prior Art]

Conventionally, vacuum suction has been carried out widely as the method for producing an inorganic short-fiber molded product. The vacuum suction is a method as follows. An inorganic short fiber and a binder of a predetermined amount are dispersed in a large amount water uniformly so as to form a slurry. A mesh die for molding is dipped in the slurry, to cause the slurry to be sucked and filtered into the inside of the mesh die, so that the fiber is laminated on the surface of the mesh die. After drying the same, a molded product is obtained.

[0003]

[Problems to be solved by the invention]

However, by the vacuum suction, it is difficult to form a small-size molded product with a precise dimension accuracy or a solid molded product. Furthermore, since a binder is dissolved or dispersed in a solvent such as water, it is diluted to a low concentration. Therefore, it is impossible to obtain a molded product having a strength enough to be durable in handling. A method in which the slurry is subjected to pressure dehydration has been proposed, but as long as a state of the slurry is concerned, as in the vacuum suction, the binder is dissolved or dispersed in a solvent such as water thereby having a low concentration. As a result, it is impossible to obtain a molded product having a strength enough to be durable in handling.

[0004]

In light of the foregoing problems as described above regarding the prior art, an object of the present invention is to provide a method for producing a fiber molded product for use in a reinforced metal that enables mass production of a relatively-small molded product with an excellent dimension accuracy, and to provide a solid and strong fiber molded product for use in a reinforced metal, which has a high void ratio.

[0005]

[Means for solving problems]

The present invention is a fiber molded product for use in a reinforced metal, and a method of producing the same without a slurry state at any step.

[0006]

A first aspect of the present invention is a method for producing a fiber molded product for use in a reinforced metal as follows. The method includes subjecting a mixture to pressure forming in which dehydration is not carried out, and carrying out dehydration by heating after the pressure forming. The mixture has a water content of 5 wt% to 25 wt%, and contains one or not less than two kinds of inorganic short fibers with a length of 0.01 mm to 3 mm, and one or not less than two types of binders. The inorganic short fibers are selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker. The binders are selected from colloidal alumina, colloidal silica, and colloidal zirconium. A second aspect of the present invention is a fiber molded product for use in a reinforced metal as follows. The fiber molded product has a void ratio of 60 % to 90 %, and a compression strength of not less than 4.6 kgf/cm^2. The fiber molded

product includes one or not less than two kinds of inorganic short fibers with a length of 0.01 mm to 3 mm, and one or not less than two types of binders. The inorganic short fibers are selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker. The binders are selected from colloidal alumina, colloidal silica, and colloidal zirconium. Furthermore, a third aspect of the present invention is a fiber molded product for use in a reinforced metal, which includes an inorganic short fiber with a length of 0.01 mm to 3 mm and a binder, and having a void ratio of 60 wt% to 95 wt%. In the fiber molded product, 10 wt% to 70 wt% of mullite whisker and 30 wt% to 90 wt% of aluminum borate whisker are used as the inorganic fiber, and colloidal alumina is used as the binder.

[0007]

[Functions]

The aluminum borate whisker used as the inorganic short fiber has a property of incurring spring back to a great extent when the pressure is released after the pressing formation. The reason is that the whisker has a tensile strength of 800 kgf/mm^2 and a modulus of elasticity of 40,000 kgf/mm^2, which are both great. Therefore, whiskers are not broken even when being pressed.

[0008]

In the press forming, the mullite whisker used as the inorganic short fiber tends to cause the bulk density of the molded product to increase, thereby causing the void ratio to decrease. The reason is as follows. The mullite whisker has a small aspect ratio as compared with that of the aluminum borate whisker, and since it has a small tensile strength and a small modulus of elasticity, the whisker is broken upon the pressing. As a result, the whisker has a further reduced aspect ratio.

[0009]

Therefore, the appropriate use of these inorganic short fibers enables the achievement of the object of the present invention.

[0010]

[Embodiments]

The following will describe preferred embodiments of the present invention.

[0011]

The fiber molded product for use in a reinforced metal of the present

invention is composed of an inorganic short fiber with a length of 0.01 mm to 3 mm and a binder. One or two selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker are used as the inorganic short fiber. One or two selected from colloidal alumina, colloidal silica, and colloidal zirconium are used as the binder. The void ratio of the fiber molded product for use in a reinforced metal is set to be in a range of 60 % to 95 %.

[0012]

Furthermore, according to a method for producing a fiber molded product for use in a reinforced metal of the present invention, a molded product in a desired shape is obtained by subjecting a mixture to pressure molding, the mixture containing one or not less than two types of inorganic fibers having a length of 0.01 mm to 3 mm, which are selected from aluminosilicate fiber, mullite whisker, and aluminum borate whisker, and one or not less than two types of binders selected from colloidal alumina, colloidal silica, and colloidal zirconium. Here, a water content of the mixture is adjusted within a range of 5 wt% to 25 wt%. Thereafter, the molded product is dehydrated by heating. Thus, the fiber molded product for use in a reinforced metal is produced.

[0013]

By forming a molded product by pressure molding, it is possible to obtain a solid product with substantially the same dimensions as those of the die. Furthermore, the pressure molding allows a binder with a high concentration to be used as compared with the conventional vacuum suction, thereby obtaining a molded product with a high strength.

[0014]

The aluminosilicate fiber used as the inorganic short fiber is amorphous ceramic fiber composed of 30 wt% to 60 wt% of Al_2O_3, 30 wt% to 60 wt% of SiO_2, and 0 wt% to 25 wt% of other components. The aluminosilicate fiber generally has heat resistance even at 1200°C to 1500°C, and exhibits abrasion resistance at a Mohs hardness in a range of 5 to 7.

[0015]

The mullite whiser used as the inorganic short fiber has a chemical composition ranging from $3Al_2O_3$-$2SiO_2$ to $2Al_2O_3$-SiO_2, and is an acicular crystal containing mullite as a principal component. Furthermore, it has an aspect ratio of not less than 10.

[0016]

The aluminum borate whisker used as the inorganic short fiber is a compound made of aluminum oxide and boron oxide, having a chemical composition of $9Al_2O_3$-$2B_2O_3$, and having an acicular crystal.

[0017]

The inorganic short fiber used in the present invention preferably has a length of 0.01 mm to 3 mm. If the fiber is shorter than 0.01 mm, that is, 10 μm, the molded product has an increased density with a reduced void ratio. In contrast, if the fiber is longer than 3 mm, the chargeability of the same into a press die impairs.

[0018]

The void ratio of the molded product preferably is 60 % to 95 %. If the void ratio is smaller than 60 %, the chargeability of the metal impairs. In contrast, the void ratio exceeds 95 %, the strength of the fiber-reinforced metal cannot be increased sufficiently.

[0019]

A mixture ratio of mullite whisker and aluminum borate whisker is determined so that the content of the mullite whisker is 10 wt% to 70 wt%, more preferably 20 wt% to 50 wt%. The content of the aluminum borate whisker exceeds 90 wt%, an excessive spring back occurs when the pressure is released after the press forming. If the content of mullite whisker exceeds 70 wt%, the bulk density increases, causing the void ratio to decrease excessively.

[0020]

The following will describe Examples 1 to 6.

[0021]

Mullite whisker and aluminum borate whisker were prepared at a predetermined ratio, and were mixed by an agitator so as to be homogeneous. Then, a predetermined alumina sol was added thereto, and the mixture was agitated several minutes more. The mixture was charged into a die of a press forming device, and was subjected to press forming at a pressure of 50 kgf/cm^2 to 100 kgf/cm^2. After drying the same using a drier, it was subjected to a heat treatment at 1200°C for three hours. Fiber molded products for use in a reinforced metal of Examples 1 to 6 were obtained through this process. Then, compression strengths and void ratios of the fiber molded products for use in a reinforced metal of Examples 1 to 6 were measured. The formulations of the mixtures thus prepared and

the measured results are shown in Table 1 below.

[0022]

[Table 1]

Example Number	Mullite Whisker (Parts by Weight)	Aluminum Borate Whisker (Parts by Weight)	10% Solution of Alumina Sol (Parts by Weight)	Void Ratio (%)	Compression Strength (kgf/cm^2)
Ex. 1	0	100	15	90	4.6
Ex. 2	100	0	15	70	5.2
Ex. 3	100	100	30	75	10.4
Ex. 4	80	100	27	75	12.5
Ex. 5	0	100	15	75	8.9
Ex. 6	100	0	15	97	---

As a method for charging a metal into a molded product according to the present invention, a generally-performed method such as molten metal forging, low-pressure forging, die casting, etc. can be applied. Here, aluminum, magnesium, copper, zinc, tin, and alloys containing any one of these as a principal component can be used as a metal to be charged.

[0023]

The fiber-reinforced metals can be used in, for instance, sliding portions of various types of devices, so as to improve the specific strength and the abrasion resistance, as well as to reduce the weight.

[0024]

[Effects of the invention]

According to the fiber molded product for use in a reinforced metal and a method for producing the same of the present invention as set forth in claims 1 and 2, the product is produced without a slurry state at any step. Therefore, it is possible to readily produce a relatively small molded product with an excellent dimension accuracy, and to obtain a strong and solid molded product with a high void ratio.

[0025]

Furthermore, by using the product as set forth in claim 3, a fiber-reinforced metal can be obtained that has an improved abrasion characteristic and causing less damage against a device component in contact as compared with the fiber-reinforced metals in which conventional silicon carbide whisker or aluminum fiber are used.